

### **REMARKS**

Reconsideration of the application is requested in view of the amendments to the claims and the remarks presented herein.

The claims in the application are claims 1 to 3, 5 to 22 and 36 to 48, all other claims having been cancelled. Claims 9, 10, 12, 13, 20 to 22 and 36-44 were deemed drawn to allowable subject matter.

Claims 4, 7, 9, 10 and 12 were rejected under 35 USC 112, 1<sup>st</sup> paragraph as lacking specific support for x and y. Claim 4 has been cancelled and the objected terms do not appear in the remaining claims thereby obviating this rejection.

Claims 3 to 22 were rejected under 35 USC 112, second paragraph as being indefinite. The Examiner objected to the use of a trademark in claim 3 and claims 5 and 11 were objected as lacking antecedent basis. Claim 45 was objected to as being improperly dependent form.

Applicants traverse these grounds of rejection since the amended claims are definite. Proper antecedent basis is provided in claims 5 and 11 and x and y no longer appear in the claims. No trademarks appear in the claims and claim 45 has been rewritten. Therefore, withdrawal of these grounds of rejection is requested.

Claims 1, 7, 8, 11, 14 to 19, 23 to 27, 29 and 31 to 34 were rejected under 35 USC 102 as being anticipated or under 35 USC 103 as being obvious over the Breysse et al patent which according to the Examiner teaches a hydrorefining catalyst comprising ruthenium sulfide and cobalt and/or nickel sulfide on a refractory oxide support which renders applicants' catalyst anticipated or obvious.

Applicants respectfully traverse this ground of rejection since the Breysse et al patent does not render applicants' catalysts obvious or anticipated by the reference. Applicants like to point out that the present invention is directed to an electrocatalyst for the reduction of oxygen, and that one of the obvious requirement for an electrocatalyst, especially since its intended use is as a component of a gas-diffusion electrode, is being electrically conductive. For this reason, only conductive carbons were considered throughout the description, particularly with reference to the examples. The presently amended set of claims reflects this limitation, and claims a ruthenium sulfide supported on a conductive carbon.

The catalyst of Breysse et al is not directed to an electrochemical process, but rather to a hydrorefining chemical process and the disclosed support thereof is not a conductive carbon, being instead a refractory oxide. Refractory oxides are a different class of materials from carbons, and furthermore they generally are insulating materials, so that Breysse et al does not anticipate the present invention at all

As an alternative, the claims were rejected under 35 USC 103 (a) for lacking inventive step over Breysse et al. Applicants traverse such grounds of rejection, since one skilled in the art would never resort to the invention of Breysse et al to produce an electrocatalyst for oxygen reduction having a negligible solubility in a chlorinated hydrochloric environment. Breysse et al is not directed to electrocatalysts at all, but rather to catalysts supported on electrically insulating materials. Oxygen reduction is not mentioned for this catalyst and the reaction environment is completely different. The fact that the catalyst of Breysse et al is assumed to be insoluble in a chlorinated and optionally oxygenated hydrochloric environment is also incorrect because the stability of a catalyst is a combination of properties of catalyst and support, moreover depending on the chemical route of preparation since it is heavily influenced by the nature and concentration of impurities and unconverted precursors, which may facilitate its dissolution. We therefore believe that claims 1, 7, 8, 11 14-19 of the instant invention are neither anticipated nor rendered obvious by the cited patent.

Conversely, the Examiner is correct in assuming that Breysse et al would give useful indications to one skilled in the art wishing to support a ruthenium sulfide catalyst on a generic carbon support. Since the subject matter of claims 23-35 is a method for the production of a supported catalyst which is not specific of the selected carbon support, these claims were cancelled from the application.

Claims 1, 7, 8, 11, 16 to 18, 23 to 27, 29 to 33 and 35 were rejected as being obvious over the Raybaud et al patent which according to the Examiner teaches a catalyst

for hydrorefining and hydro converting hydrocarbon feeds which catalyst is a mixed sulfide of at least 2 elements of atomic nos. 3, 11, 12, 19 to 33, 37 to 51, 55 to 83 and 87 to 103. The Examiner concedes the reference is not disclosed as being suitable for oxygen reduction which is only a statement of intended use and of no patentable weight

Applicants respectfully traverse this ground of rejection since Raybaud et al is directed to a completely different kind of catalyst. First of all, the catalyst of Raybaud et al is not supported, but is rather an unsupported catalyst embedded into a matrix, as one skilled in the art will easily appreciate. Again, the particular application for which this catalyst is designed is a hydrorefining chemical process. There is absolutely no teaching to be derived from this document in the field of electrocatalysis. The catalyst of Raybaud et al possesses no electrical conductivity and therefore one skilled in the art would assume it has no catalytic property versus the electroreduction of oxygen. Also the alleged stability in a chlorinated hydrochloric environment appears to be questionable at best, for the same reasons stated in the discussion of Breysse et al. The catalysts of Breysse et al and of Raybaud et al are directed to be used in contact with hydrocarbons having no attitude to solubilize or corrode a ruthenium sulfide supported catalyst. Therefore it can be assumed that this particular feature has been completely disregarded in the frame of these inventions. Therefore, withdrawal of this ground of rejection is requested.

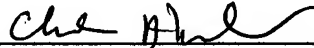
Claims 1 to 6, 23, 28 and 29 were rejected under 35 USC 103 as being obvious

over the Dubeck et al patent which according to the Examiner teaches a sulfide-modified ruthenium catalyst deposited on carbon and a process for preparing the same. The Examiner deems the use of the catalyst has no patentable weight.

Applicants respectfully traverse this ground of rejection. Applicants will concede that this document is the closest prior art, as Dubeck et al disclose a carbon supported ruthenium catalyst with some degree of sulfide modification. Again, however, the catalyst of Dubeck et al is not an electrocatalyst, and the use of conductive carbon as a support is not specific. In particular, carbons cited in the examples, such as Calgon BL are not conductive carbons. Applicants definitely traverse assumption that one skilled in the art would assume that catalysts cited in Dubeck et al would have any activity in the electrochemical reduction of oxygen, since they lack electrical conductivity which is essential to support such process. Also the chemical stability in a chlorinated hydrochloric environment has to be questioned. In the present specification, it is clearly set forth in the "state of the art" section (and confirmed by the counterexample) that ruthenium sulfides obtained by conventional wet chemistry are not stable in hydrochloric environments. The catalysts of Dubeck et al are obtained from aqueous suspensions of the support and not by incipient wetness impregnation. Therefore, they are much closer to the catalyst of the counterexample than those of the invention, and one can safely assume that they are not stable in a hydrochloric environment. Also the catalyst of Dubeck et al is in fact used in non aggressive environments (e.g. sorbitol aqueous solutions), and its chemical stability in a hydrochloric environment has been completely disregarded by the authors. Therefore, withdrawal of this rejection is requested.

In summary, the catalyst of the invention shows unexpected electrochemical performances and chemical stability clearly depending on features, including the nature of the support which must be electrically conductive and the fact that it is obtained via incipient wetness impregnation thereof. The catalysts of the cited prior art are obtained on different, non-conductive supports and this is, in itself a sufficient reason for asking that the outstanding rejections based on novelty and inventive step be waived. Therefore, favorable reconsideration of the application is requested.

Respectfully submitted,  
Hedman and Costigan



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Enclosures